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# Validation of Armed Services Vocational Aptitude Battery (ASVAB) Selector Composites: Boiler Technician (BT), Machinist's Mate (MM), and Engineman (EN) Ratings



Janet D. Held
Charles W. Johns

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Janet D. Held
Charles W. Johns

Reviewed and approved by
W. A. Sands

Released by
*J. D. McAfee*
Captain, U.S. Navy
Commanding Officer
and
J. Silverman
Technical Director (Acting)



Navy Personnel Research and Development Center
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The purpose of this study was to validate Armed Services Vocational Aptitude Battery (ASVAB) composites for the 4- and 6-year obligor (4YO/6YO) programs of the BT, MM, and EN ratings (only BT and MM have 6YO programs). The ASVAB consists of the following 10 tests: General Science (GS), Arithmetic Reasoning (AR), Word Knowledge (WK), Paragraph Comprehension (PC), Numerical Operations (NO), Coding Speed (CS), Auto and Shop Information (AS), Mathematics Knowledge (MK), Mechanical Comprehension (MC), and Electronics Information (EI). Verbal (VE) is comprised of WK and PC.

The study recommends that (1) the BT, MM, and EN 4YO programs retain their operational selector composite, MK+AS, and minimum qualifying score, 96, and (2) the BT and MM 6YO programs replace their two operational selector composites, MK+AS and VE+AR with the Navy Electronics composite, AR+MK+EI+GS, which was recommended for the Gas Turbine Systems 6YO programs, Electrical (GSE) and Mechanical (GSM). The recommended minimum qualifying score for AR+MK+EI+GS is 210, the same score recommended for the GSE/GSM 6YO programs. To determine if 210 is adequate, expectancy analyses should be conducted for the 6YO programs after implementing AR+MK+EI+GS=210 and sufficient data become available.

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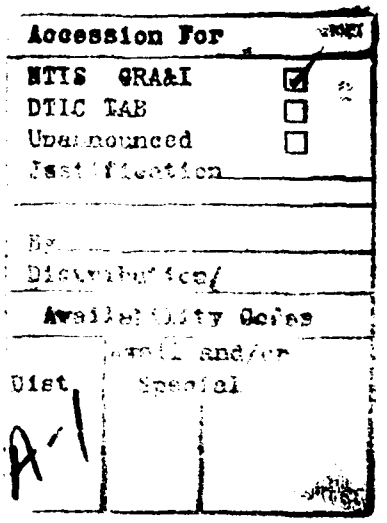
# Foreword

This study was conducted in response to a request from the Chief of Naval Personnel (PERS-23) to validate the Armed Services Vocational Aptitude Battery (ASVAB) selection criteria for the Boiler Technician (BT), Machinist's Mate (MM), and Engineman (EN) ratings for both the 4- and 6-year obligor (4YO/6YO) programs (only BT and MM have 6YO programs). The study was requested in conjunction with one requested and completed for the Gas Turbine Systems Technician ratings, Electrical (GSE) and Mechanical (GSM) (Held & Foley, 1991). The BT, MM EN and GSE/GSM ratings are all engineering ratings. The study was completed in October 1989 (Held, 1989). The recommendations were implemented in March 1990.

This effort was sponsored by PERS-23 and funded by reimbursable Work Unit 93WRPS578. Results, which are published at this time for archival purposes, are intended for use by the Bureau of Naval Personnel, Navy school officials, and the research community.

J. D. McAFEE
Captain, U.S. Navy
Commanding Officer

J. SILVERMAN
Technical Director (Acting)



# Summary


## Problem

This study was conducted in response to a request from the Chief of Naval Personnel (PERS-23) to validate the Armed Services Vocational Aptitude Battery (ASVAB) selection criteria for the Boiler Technician (BT), Machinist's Mate (MM), and Engineman (EN) ratings for both the 4- and 6-year obligor (4YO/6YO) programs (only BT and MM have 6YO programs). The ASVAB consists of the following 10 tests: General Science (GS), Arithmetic Reasoning (AR), Word Knowledge (WK), Paragraph Comprehension (PC), Numerical Operations (NO), Coding Speed (CS), Auto and Shop Information (AS), Mathematics Knowledge (MK), Mechanical Comprehension (MC), and Electronics Information (EI). Verbal (VE) is comprised of WK and PC.

The study was requested in conjunction with one requested and completed for the Gas Turbine Systems Technician ratings, Electrical (GSE) and Mechanical (GSM) (Held & Foley, 1991). Because the BT, MM, EN, and GSE/GSM ratings are all engineering ratings, consistent with Navy consolidation efforts, ASVAB selection standards recommended for GSE/GSM were evaluated for BT, MM, and EN.

## Objectives

The objectives of this research were to (1) validate the operational ASVAB selector composites against BT, MM, and EN "A" school performance measures, (2) identify and evaluate alternative ASVAB composites that would be more effective for determining qualification for "A" school assignment, and (3) determine a minimum qualifying score for the recommended selector composite that would reduce "A" school attrition without significantly reducing the percentage of Navy recruits available for school assignment.

## Approach

Each of the BT, MM, and EN school samples was randomly divided into a test selection sample and a holdout sample. Two methods used a multiple regression procedure with the test selection sample to determine the most valid ASVAB selector composite. The first, Method I, did not correct for restriction in range of test scores that resulted from the ASVAB selection, while the second, Method II, did. Experimental composites identified from Methods I and II and the operational selector composite(s) were validated in the holdout sample. Validities were compared after correcting for restriction in range. When replacing the operational composite was warranted (assessed from increase in validity or expected improvement in the "A" school graduation rate), an existing Navy operational selector composite most similar to the experimental composite was evaluated as a candidate replacement.

Minimum qualifying scores for adequate operational composites and for proposed replacements were evaluated on the basis of (1) attrition rate, (2) waiver rate, (3) annual school input requirement, (4) percentage of the recruit population qualifying for school selection, and (5) the number of school graduates disqualified from school selection.

**Results and Conclusions**

The operational selector composite, MK+AS, was adequate for the BT, MM, and EN 4YO programs, as was the minimum qualifying score, 96.

The Electronics composite, AR+MK+EI+GS, the operational selector composite for the GSE/GSM ratings, had higher validity than the operational composite, MK+AS, for the BT 6YO program (validity was comparable for the other operational composite, VE+AR). The validity for AR+MK+EI+GS was slightly higher than the validities for the two operational composites for the MM 6YO program. A minimum qualifying score of 210, recommended for the GSE/GSM 6YO programs, was appropriate for the BT and MM 6YO programs.

**Recommendations**

The following recommendations are addressed to PERS-23:

1. The BT, MM, and EN 4YO programs should retain their operational selector composite, MK+AS, and minimum qualifying score, 96, for school selection.

2. The AR+MK+EI+GS composite should replace VE+AR and MK+AS as the operational selector composite for the BT and MM 6YO programs. The recommended minimum qualifying score for AR+MK+EI+GS is 210, the same score recommended for the GSE/GSM 6YO programs.

Expectancy analyses should be conducted for the BT and MM 6YO programs after AR+MK+EI+GS is implemented and sufficient data become available to determine if the 210 minimum qualifying score is adequate.

At the time of this study, plans for converting Navy ships from steam to gas turbine were unclear. If the conversion takes place, BT, MM, and EN personnel could be retrained for the GS ratings. A smoother transition may result if the ASVAB selection standards for the BT, MM, EN, and GS ratings are the same.

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# Introduction

## Background and Problem

This study was conducted in response to a request from the Chief of Naval Personnel (PERS-23) to validate the Armed Services Vocational Aptitude Battery (ASVAB) selection criteria for the Boiler Technician (BT), Machinist's Mate (MM), and Engineman (EN) ratings for both the 4- and 6-year obligor (4YO/6YO) programs (only BT and MM have 6YO programs).

The study was requested in conjunction with one requested and completed for the Gas Turbine Systems Technician ratings, Electrical (GSE) and Mechanical (GSM) (Held & Foley, 1991). The BT, MM, EN, and GSE/GSM ratings are all engineering ratings. Because the BT, MM, EN, and GSE/GSM ratings are all engineering ratings, consistent with Navy consolidation efforts, ASVAB selection standards recommended for GSE/GSM were evaluated for BT, MM, and EN.

The ASVAB consists of the following 10 tests: General Science (GS), Arithmetic Reasoning (AR), Word Knowledge (WK), Paragraph Comprehension (PC), Numerical Operations (NO), Coding Speed (CS), Auto and Shop Information (AS), Mathematics Knowledge (MK), Mechanical Comprehension (MC), and Electronics Information (EI). These tests, described briefly in Table 1, are used by each service in various combinations (composites) to select recruits into military occupations. The Navy has 11 operational ASVAB selector composites, listed in Table 2. Periodically, studies are conducted to correlate ASVAB composites with Class "A" school performance measures to determine if the school is using the most effective (valid) operational selector composite. For schools that have more than one ASVAB requirement (two selector composites and/or a minimum qualifying score for a composite test), analyses must support their use as screening instruments that do not eliminate valuable Navy talent from "A" school assignments.

Table 3 lists attrition rates for the data used in this study, which were collected for the 4-year period from January 1985 through December 1988. Table 3 also lists sample sizes, waiver rates (percentage of students scoring below the operational composite minimum qualifying score), and fiscal year (FY) 1989 school input requirements. While attrition rates for the five programs in this validation study are low to moderate, the Navy Integrated Training Resources and Administration System reports attrition for a recent 1-year period for the 6YO follow-on "C" schools as more severe (31% for BT; 20% for MM). Therefore, "C" school as well as "A" school attrition rates were considered in assessing BT and MM 6YO ASVAB selection standards.

## Objectives

The objectives of this research were to (1) validate the operational ASVAB selector composites against BT, MM, and EN school performance measures, (2) identify and evaluate alternative ASVAB composites that would be more effective for determining qualification for "A" school assignment, and (3) determine a minimum qualifying score for the recommended selector composite that would reduce "A" school attrition without significantly reducing the percentage of Navy recruits available for school assignment.

**Table 1**

**Content of ASVAB Tests**

| Test | Abbreviation | Description |
|---|---|---|
| General Science | GS | A 25-item test of knowledge of the physical (13 items) and biological (12 items) sciences--11 minutes. |
| Arithmetic Reasoning | AR | A 30-item test of ability to solve arithmetic word problems--36 minutes. |
| Word Knowledge[a] | WK | A 35-item test of knowledge of vocabulary, using words embedded in sentences (11 items) and synonyms (24 items)--11 minutes. |
| Paragraph Comprehension[a] | PC | A 15-item test of reading comprehension--13 minutes. |
| Numerical Operations | NO | A 50-item speed test of ability to add, subtract, multiply, and divide one- and two-digit numbers--3 minutes. |
| Coding Speed | CS | An 84-item speed test of ability to recognize numbers associated with words from a table--7 minutes. |
| Auto and Shop Information | AS | A 25-item test of knowledge of automobiles, shop practices, and use of tools--11 minutes. |
| Mathematics Knowledge | MK | A 25-item test of knowledge of algebra, geometry, fractions, decimals, and exponents--24 minutes. |
| Mechanical Comprehension | MC | A 25-item test of knowledge of mechanical and physical principles--19 minutes. |
| Electronics Information | EI | A 20-item test of knowledge of electronics, radio and electrical principles and information--9 minutes. |

[a]Verbal Score: VE = WK + PC (raw scores).

**Table 2**

**Navy Operational ASVAB Selector Composites**

| Composite | Components |
|---|---|
| General Technical | VE+AR |
| Mechanical | VE+MC+AS |
| Electronics | AR+MK+EI+GS |
| Clerical | VE+NO+CS |
| Basic Electricity & Electronics | AR+2MK+GS |
| Engineering | MK+AS |
| Cryptologic Technician | VE+AR+NO+CS |
| Hospitalman | VE+MK+GS |
| Machinery Repairman | AR+MC+AS |
| Submarine | VE+AR+MC |
| Business/Clerical[a] | VE+MK+CS |

Note. See Table 1 for full test names.

[a]Student Testing Program composite implemented July 1987.

**Table 3**

**BT, MM, and EN Class "A" School Samples**

| Program | Attrition Rate (%) | | | Sample Size | Waiver Rate[a] (%) | FY89 School Input Requirement |
|---|---|---|---|---|---|---|
| | Academic | Nonacademic | Total | | | |
| BT 4YO | 6.3 | 6.5 | 12.8 | 4,596 | 8.3 | 1,001 |
| MM 4YO | 6.5 | 6.8 | 13.3 | 6,141 | 4.0 | 2,192 |
| EN 4YO | 1.9 | 4.1 | 6.0 | 4,356 | 10.0 | 1,205 |
| BT 6YO | 1.7 | 5.6 | 7.3 | 781 | 10.0 | 356 |
| MM 6YO | 1.1 | 4.2 | 5.3 | 756 | 11.0 | 429 |

Note. Data were collected from January 1985 through December 1988.

[a]Waiver rate is the percentage of students who score below the operational composite minimum qualifying score.

# Approach

## Predictors

The predictors used in this study were the 10 tests of ASVAB Forms 8 through 14, described briefly in Table 1. Raw test scores were standardized to a mean of 50 and a standard deviation of 10 using norms obtained from the American Youth Population (Department of Defense, 1982).

## Criterion

The criterion was final school grade (FSG) provided by the BT, MM, and EN "A" schools. Although FSG is scaled from 0 to 100, passing scores are usually between 70 and 100. A mathematical procedure developed by Abrahams and Alf (1992) and detailed in Appendix A estimated FSGs for attrites.

## Samples

See Table 3 for the BT, MM, and EN sample sizes and a breakdown of academic and nonacademic attrition rates.

## Data Analyses

Each of the BT, MM, and EN school samples was randomly divided into a test selection sample (60% of the students) and a holdout sample (40% of the students). Prior to this assignment, students were sorted into graduates, academic attrites, and nonacademic attrites to ensure equal percentages were present in the test selection and holdout samples.

Two methods were used with the test selection sample to determine the ASVAB composite most predictive of FSG. Both methods use a forward stepwise multiple regression procedure in which a prediction equation starts with the ASVAB test that has the highest correlation with FSG, followed by tests that provide the largest increase in the multiple correlation.[1] The first four tests to enter the equation were designated as the experimental selector composite. Method I did not correct for restriction in range of ASVAB test scores resulting from ASVAB selection, while Method II did. The multivariate correction procedure for Method II is explained in Appendix B (Lawley, 1943) where it is applied to BT 4YO data. Results from the multiple regression analysis for Methods I and II, also for BT 4YO data, are in Appendix C.

The most predictive composites identified by the two methods and the operational selector composite(s) were then cross-validated in the holdout sample. Composite scores (used to correlate with FSG) were calculated by summing standardized test scores. This procedure unit weights each test.[2]

Composite validities were compared after correcting for restriction in range. Replacing the operational selector composite was recommended when the experimental demonstrated (1) a .05 increase in validity or (2) a 2% improvement in the graduation rate.[3]

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[1]For the multiple regression, WK and PC were combined into the ASVAB Verbal (VE) composite.

[2]Unit weights generalize to cross-validation samples more successfully than exact weights derived from regression analysis (Dawes & Corrigan, 1974). However, regression weights determine optimal assignment in models of classification efficiency (Brogden, 1955).

[3]The Taylor Russel tables (1939) were used to translate gain in validity into expected gain in the graduation rate.

When replacing an operational composite was warranted, existing Navy operational selector composites (Table 2) most similar to the experimental composite were evaluated as candidate replacements. The choice is limited to Navy operational selector composites because, over the course of numerous validation studies, implementing statistically derived composites could result in an operationally unmanageable number of highly correlated operational selector composites.[4]

Finally, minimum qualifying scores for adequate operational composites and for proposed replacements were evaluated on the basis of (1) attrition rate, (2) waiver rate, (3) annual school input requirement, (4) percentage of the recruit population qualifying for school selection, and (5) the number of school graduates disqualified from school selection.

# Results and Conclusions

## Experimental Selector Composites

Table 4 lists the experimental composites identified by Methods I and II for the BT, MM, and EN programs.

**Table 4**

**Experimental Composites Identified for the BT, MM, and EN Test Selection Samples**

| Rating/Program | Method I | | Method II |
|---|---|---|---|
| BT 4YO | AR+EI+MK+MC | <———> | AR+EI+MK+MC |
| MM 4YO | AR+MC+MK+EI | <———> | AR+MC+MK+EI |
| EN 4YO | EI+AR+GS+MC | | AR+EI+GS+AS |
| BT 6YO | EI+MK+MC+VE | | EI+AR+MK+VE |
| MM 6YO | MK+MC+GS+CS | | MK+MC+VE+EI |

Notes.
1. See Table 1 for full test names.
2. Arrows indicate that Methods I and II identified the same composite.

Table 5 lists validities (uncorrected, $r_u$; corrected, $r_c$) for the operational and experimental selector composites for the BT, MM and EN programs. Corrected validities were compared for this study.

For the BT, MM, and EN 4YO programs, the validities for the experimental composites were between .02 and .04 higher than the validities for the operational composite, MK+AS. The Taylor

[4]A new composite could be implemented for the Navy, as was the case of the Business/Clerical composite (Table 2), if an experimental composite was consistently derived for a number of schools within an occupational group but was not one of the existing Navy operational selector composites.

**Table 5**

**Operational and Experimental Composite Cross-Validities for the BT, MM, and EN Holdout Samples**

| Operational/Experimental Composite | Cross-Validities[a] $r_u$ | $r_c$ |
|---|---|---|
| **BT 4YO** | | |
| MK+AS (Operational) | .26 | .39 |
| AR+EI+MK+MC (Experimental-Methods I & II) | .31 | .43 |
| **MM 4YO** | | |
| MK+AS (Operational) | .29 | .43 |
| AR+MC+MK+EI (Experimental-Methods I & II) | .32 | .45 |
| **EN 4YO** | | |
| MK+AS (Operational) | .37 | .58 |
| EI+AR+GS+MC (Experimental-Method I) | .44 | .62 |
| AR+EI+GS+AS (Experimental-Method II) | .42 | .61 |
| **BT 6YO** | | |
| MK+AS (Operational) | .28 | .56 |
| VE+AR (Operational) | .24 | .55 |
| EI+MK+MC+VE (Experimental-Method I) | .34 | .59 |
| EI+AR+MK+VE (Experimental-Method II) | .33 | .59 |
| **MM 6YO** | | |
| MK+AS (Operational) | .38 | .60 |
| VE+AR (Operational) | .29 | .54 |
| MK+MC+GS+CS (Experimental-Method I) | .41 | .61 |
| MK+MC+VE+EI (Experimental-Method II) | .44 | .64 |

Note. See Table 1 for full test names.

[a]Both $r_u$ and $r_c$ (validities uncorrected and corrected for restriction in range, respectively) are Person product-moment correlations. Multivariate formulas were used for corrections.

Russell tables (1939) translate these validity gains into less than 1% expected increases in graduation rates, which does not warrant replacing the operational selector composite for the 4YO programs.

For the BT 6YO program, the validity of .59 for the two experimental composites, EI+MK+MC+VE and EI+AR+MK+VE, was .03 higher than the validity of .56 for the operational composite, MK+AS, and .04 higher than the validity of .55 for the operational composite, VE+AR. The .04 validity increase translates into a 2% expected increase in the graduation rate, which warrants evaluation of candidate replacement composites for the BT 6YO program.

For the MM 6YO program, the validity of .64 for the experimental composite, MK+MC+VE+EI, was .04 higher than the validity of .60 for the operational composite, MK+AS, and .10 higher than the validity of .54 for the operational composite, VE+AR. Both validity increases translate into a 2% expected increase in the graduation rate, which warrants evaluation of candidate replacement composites for the MM 6YO program.

**Candidate Composite Selection and Evaluation: BT and MM 6YO Programs**

Of the Navy operational selector composites in Table 2, the Electronics composite, AR+MK+EI+GS, and the Submarine composite, VE+AR+MC, were selected as candidate replacement composites for the BT and MM 6YO programs because they are most similar to the BT and MM 6YO experimental composites (from Table 5, EI+MK+MC+VE and EI+AR+MK+VE for BT 6YO; MK+MC+GS+CS and MK+MC+VE+EI for MM 6YO).

Table 6 lists the uncorrected and corrected cross-validities for the candidate composites for the BT and MM 6YO holdout samples.

**Table 6**

**Candidate Composite Cross-Validities for the BT and MM 6YO Holdout Samples**

| Candidate Composites | Cross-Validities[a] | |
|---|---|---|
| | $r_u$ | $r_c$ |
| **BT 6YO** | | |
| AR+MK+EI+GS (Candidate I) | .34 | .60 |
| VE+AR+MC (Candidate II) | .32 | .58 |
| **MM 6YO** | | |
| AR+MK+EI+GS (Candidate I) | .39 | .61 |
| VE+AR+MC (Candidate II) | .42 | .62 |

Note. See Table 1 for full test names.

[a]Both $r_u$ and $r_c$ (validities uncorrected and corrected for restriction in range, respectively) are Pearson product-moment correlations. Multivariate formulas were used for corrections.

For BT 6YO and MM 6YO, respectively, the validities of .60 and .61 for the candidate I composite, AR+MK+EI+GS, and the validities of .58 and .62 for the candidate II composite, VE+AR+MC, were comparable to the validities for the two programs' experimental composites. Further evaluation suggests that AR+MK+EI+GS should be the proposed operational selector composite for the two 6YO programs because AR+MK+EI+GS is the only existing Navy operational selector composite containing the EI test, which was found in three of the four 6YO experimental composites (see Table 4). Also, AR+MK+EI+GS is the operational selector composite for the other engineering ratings, GSE and GSM.

### Minimum Qualifying Scores: BT, MM, and EN 4YO Programs

For the BT, MM, and EN 4YO programs, the current operational selector composite with minimum qualifying score, MK+AS=96, qualifies 74% of the recruit population. Given moderate attrition rates for the 4YO programs and high annual school input requirements, raising the minimum qualifying score cannot be justified.

At this time AR+MK+EI+GS, which is appropriate for the BT and MM 6YO programs, cannot be recommended for the BT, MM, and EN 4YO programs because its use, even with a low 190 minimum qualifying score, would have disqualified 30% of this study's graduates from school selection.

### Minimum Qualifying Scores: BT and MM 6YO Programs

Two AR+MK+EI+GS minimum qualifying scores were evaluated for the BT and MM 6YO programs. The first, 210, was recommended for the GSE/GSM 6YO programs (Held & Foley, 1991). The second, 218, was the minimum qualifying score for the GS programs at the time of the GSE/GSM study. Of the two scores, 210 was evaluated as most appropriate because it (1) disqualified fewer BT and MM graduates from "A" school selection (for BT, 210 and 218 disqualified 78% and 55% of the graduates, respectively; for MM, 210 and 218 disqualified 90% and 74% of the graduates, respectively) and (2) qualified more recruits for "A" school selection (210 qualifies 43%; 218, 39%). Also, 218 for AR+MK+EI+GS has already been evaluated as too high for the GSE/GSM 6YO programs.

## Recommendations

The following recommendations are addressed to PERS-23:

1. The BT, MM, and EN 4YO programs should retain their operational selector composite, MK+AS, and minimum qualifying score, 96, for school selection.

2. The AR+MK+EI+GS composite should replace VE+AR and MK+AS as the operational selector composite for the BT and MM 6YO programs. The recommended minimum qualifying score for AR+MK+EI+GS is 210, the same score recommended for the GSE/GSM 6YO programs.

Expectancy analyses should be conducted for the BT and MM 6YO programs after AR+MK+EI+GS is implemented and sufficient data become available to determine if the 210 minimum qualifying score is adequate.

At the time of this study, plans for converting Navy ships from steam to gas turbine were unclear. If the conversion takes place, BT, MM, and EN personnel could be retrained for the GS ratings. A smoother transition may result if the ASVAB selection standards for the BT, MM, EN, and GS ratings are the same.

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[5]Cited in Foreword.

[6]Cited in Appendix C.

# Appendix A

# Scoring of Failures

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The scoring of failures procedure is based on the assumption that, for a population of Navy applicants, the combined distribution of final school grade (FSG) for graduates and attrites is normal. On the basis of the mathematical properties of a normal curve, a mean FSG for attrites can be calculated at the appropriate lower point of the FSG distribution given the following values.

p = the proportion of graduates.

q = the proportion of attrites.

$\overline{X}_g$ = the mean FSG for graduates.

$SD_g$ = the standard deviation of FSGs for graduates.

z = the z-score (standard score) above which the proportion, p, falls.

y = the height of the normal curve at z.

**Step 1**

The mean FSG for attrites, $\overline{X}_a$, can be determined as follows:

$$\overline{X}_a = X_g - A\,(SD_g), \text{ where } A = \frac{y/(pq)}{\sqrt{1 + (zy/p) - (y/p)^2}}.$$

**Step 2**

Assign the estimated mean criterion score determined in step 1 to each attrite.

**Step 3**

Compute the correlation between each predictor and the criterion for the combined distribution of graduates and attrites.

**Step 4**

Correct the correlations from step 3 for coarse grouping (assigning a mean criterion score to every attrite reduces variance and, therefore, the correlation coefficient). The formula used for this correction is:

$r_c = r_{xy} / SDz'$, where

$$SDz' = \sqrt{1 - q + zy + y^2/q}.$$

# Appendix B

# Correction Procedure Used in Method II

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In order for the regression analysis used to derive the Armed Services Vocational Aptitude Battery (ASVAB) composite most predictive of final school grade (FSG) not to be biased against tests used for school selection, test scores must be corrected for restriction in range. This is accomplished in Method II by using a Navy applicant population ASVAB/FSG intercorrelation matrix where correlations between ASVAB tests and FSG are estimated using multivariate correction formulas (Lawley, 1943).

The next page gives two intercorrelation matrices (including means and standard deviations) required for the multivariate correction procedure. The first is the ASVAB/FSG intercorrelation matrix for the Boiler Technician 4-year obligor test selection sample. The second is the ASVAB intercorrelation matrix for a Navy applicant population. The population correlations between ASVAB and FSG estimated by multivariate corrections are at the bottom of the page.

## Table B-1

## Required Multivariate Matrices and Output

| | GS | AR | NO | CS | AS | MK | MC | EI | VE | FSG | Mean | SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT 4YO Test Selection Sample Intercorrelations With Means and Standard Deviations | | | | | | | | | | | | |
| GS | 1.000 | .364 | -.084 | -.007 | .415 | .326 | .472 | .544 | .688 | .182 | 50.42 | 4.33 |
| AR | | 1.000 | .212 | .183 | .191 | .606 | .459 | .330 | .393 | .229 | 50.44 | 7.19 |
| NO | | | 1.000 | .497 | -.216 | .294 | -.040 | -.111 | -.078 | .070 | 52.22 | 6.95 |
| CS | | | | 1.000 | -.095 | .204 | .056 | .034 | .056 | .104 | 51.93 | 6.91 |
| AS | | | | | 1.000 | -.063 | .474 | .534 | .414 | .125 | 55.80 | 7.27 |
| MK | | | | | | 1.000 | .339 | .232 | .303 | .222 | 49.83 | 7.13 |
| MC | | | | | | | 1.000 | .512 | .476 | .214 | 52.30 | 7.61 |
| EI | | | | | | | | 1.000 | .525 | .213 | 52.21 | 7.66 |
| VE | | | | | | | | | 1.000 | .171 | 50.72 | 6.01 |
| FSG | | | | | | | | | | 1.000 | 83.47 | 5.69 |
| Population (Applicant FY87) Intercorrelations With Means and Standard Deviations | | | | | | | | | | | | |
| GS | 1.000 | .607 | .231 | .228 | .511 | .596 | .648 | .667 | .786 | | 51.88 | 8.48 |
| AR | | 1.000 | .452 | .380 | .410 | .751 | .642 | .535 | .634 | | 51.45 | 8.49 |
| NO | | | 1.000 | .611 | .033 | .452 | .228 | .144 | .310 | | 53.12 | 7.56 |
| CS | | | | 1.000 | .048 | .368 | .230 | .166 | .333 | | 52.72 | 7.67 |
| AS | | | | | 1.000 | .274 | .629 | .656 | .454 | | 52.91 | 9.14 |
| MK | | | | | | 1.000 | .576 | .484 | .562 | | 51.20 | 8.74 |
| MC | | | | | | | 1.000 | .664 | .604 | | 53.15 | 9.37 |
| EI | | | | | | | | 1.000 | .603 | | 52.12 | 9.06 |
| VE | | | | | | | | | 1.000 | | 52.33 | 7.02 |
| Correlations (Validities) for Population From Multivariate Correction Program and Above Matrices | | | | | | | | | | | | |
| FSG | .276 | .401 | .300 | .319 | .131 | .430 | .290 | .198 | .324 | | | |

Note. See Table 1 for full test names.

# Appendix C

# Multiple Regression for Methods I and II

## Table C-1

### Multiple Regression for Methods I and II

| TEST | STEP | MULTR | RSQ | F | FSIG | RSQCH | FCH | SIGCH | REG-DF | RES-DF |
|---|---|---|---|---|---|---|---|---|---|---|
| BT4YO Test Selection Sample Method I (AR+EI+MK+MC) | | | | | | | | | | |
| AR | 1 | .2263 | .0512 | 148.702 | .000 | .0512 | 148.702 | .000 | 1 | 2755 |
| EI | 2 | .2697 | .0727 | 107.979 | .000 | .0215 | 63.863 | .000 | 2 | 2754 |
| MK | 3 | .2880 | .0829 | 82.990 | .000 | .0102 | 30.685 | .000 | 3 | 2753 |
| MC | 4 | .2943 | .0866 | 65.220 | .000 | .0037 | 11.005 | .001 | 4 | 2752 |
| Recruit Applicant Population (FY87) Method II (AR+EI+MK+MC) | | | | | | | | | | |
| AR | 1 | .3490 | .1218 | | | .1218 | | | | |
| EI | 2 | .3865 | .1494 | | | .1494 | | | | |
| MK | 3 | .4002 | .1602 | | | .1602 | | | | |
| MC | 4 | .4050 | .1640 | | | .1640 | | | | |

Note. See Table 1 for full test names.

The multiple regression results ($SPSS_X$, 1983) for Method I show that EI is entered into the composite equation at step 2, at which point the multiple correlation for the composite AR+EI is .2697. The squared multiple correlation (the proportion of final school grade (FSG) variance accounted for by the composite) is .0727. The F statistic to determine the significance of the predictive relationship between the composite AR+EI and FSG is 107.979. The probability that this predictive relationship is due to chance is less than .001. The change in the squared multiple correlation upon entering the EI test into the equation is .0215. The F statistic for change (to determine the significance of the increase in the predictive relationship by adding EI) is 63.863, while the probability that the significance of this addition is due to chance is less than .001. The regression and residual degrees of freedom are 2 and 2754, respectively.

Method II is based on corrected correlations. Since there are no appropriate significance tests for corrected correlations, the F tests for this method do not apply.

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